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(54) Title: PORTABLE COOKING EQUIPMENT

(57) Abstract: Portable cooking equipment comprises a post inserted into the ground near an open fire, and a control head rotatable on the post . The control head includes a bracket that pivotally supports an arm. A grill is hung from one end of the arm. A control mechanism on the control head contacts the arm near its other end. The control mechanism comprises a nut fixed to the bracket, and a screw that mates with the nut and contacts the arm. By turning the screw, the arm pivots steplessly in the bracket. The grill is hung from a shaft rotatable in the arm. The shaft rotates by means of a motor, thereby rotating the grill over the fire. The grill is thus moveable relative to the tire in three degrees of freedom. The portable cooking equipment is constructed with relatively small components that are easy to assemble, disassemble, and transport.

PORTABLE COOKING EQUIPMENT

Background of the Invention

1. Field Of The Invention. The present invention pertains to food preparation, and more particularly to apparatus that cooks food over an open fire.

2. Description Of The Related Art. It is well known to cook food over open fires. Many campers and back yard chefs prepare their food outdoors using wood or charcoal fuel on a regular basis.

To suit the unique requirements of open fire cooking, various types of equipment have been developed. The prior cooking equipment invariably included a grill of rods on which the food was placed. The grills were supported above the fire by any of a number of means. Some prior grills were supported from below around the periphery of the grill. Other grills were hung by chains or the like from an overhead support.

Another common feature of prior outdoor cooking equipment was that the grills were adjustable relative to the fire. In some cases, the grills were rotatable in a horizontal plane. Typical examples of rotatable grills may be seen in U. S. patents 5,787,873 and 5,964,212. In other cooking equipment, the grills were adjustable vertically over a fire, such as is shown

in U. S. patent 4,854,297. U. S. patent 4,094,296 discloses a cooking accessory in which a grill was capable of both vertical adjustment and horizontal rotation.

In the equipment of the 4,094,296 and 4,854,297 patents, vertical adjustment was achieved by means of pins and cooperating holes in a support stand. That design limited the positions of the grill over the fire to the locations provided by the holes. That is, the height of the grill was adjustable only in discrete increments or steps. A further handicap was that the task of removing the height adjustment pins from and reinserting them into desired holes was not only inconvenient and cumbersome, but it also distracted the user from paying full attention to the cooking food.

A disadvantage of the equipment shown in the 5,964,212 patent was that the components that rotated the grill were very close to the fire. In the 5,787,873 patent, a rotatable driving component was actually located in the fire. The rotary driving components of the two foregoing patents were thus exposed to intense heat and had a corresponding short service life.

In order for campers and other outdoorsmen to make full use of open fire cooking, their equipment should be easily transportable. A corollary requirement is that the equipment be easily assembled at the cooking site and just as easily disassembled for taking back home. Prior outdoor cooking equipment in general lacked the easy assembly, disassembly, and transport feature. As one reason, the prior equipment often included long components that were awkward to carry and store. Another reason was that tools of various kinds were often required to disassemble and reassemble the equipment.

Thus, a need exists for improvements in outdoor cooking equipment.

Summary Of The Invention

In accordance with the present invention, portable cooking equipment is provided that conveniently and steplessly adjusts the height of a grill over a fire. This is accomplished by apparatus that includes an arm that pivots in a support in response to operating a crank mechanism.

According to one aspect of the invention, the support is comprised of a post having a lower end that is removeably insertable into the ground. Preferably, the post is round and includes a base that both limits the insertion depth and that stabilizes the post in the ground. The support further comprises a control head that pivotally supports the arm and that includes the crank mechanism. To pivotally support the arm, the control head includes a bracket that is designed to interfit with and to rotate on the post upper end about a post axis. If desired, a locking screw may be incorporated into the post or control head bracket.

The arm is pivotally supported in at least one first plate of the control head bracket. For that purpose, the arm includes a pin secured to a long bar or tube of the arm. The pin is preferably closer to a first end of the arm than to a second end. The pin is supported in the bracket such that the arm is under a second plate of the bracket and the pin longitudinal axis is perpendicular to the post axis.

The crank mechanism comprises a nut fixed to the bracket second plate. A screw of a crank is generally parallel to the post axis, and it mates with the nut. The free end of the screw has a pad.

The grill is hung from the second end of the arm, such as by three or more chains connected between the grill and a shaft on the arm second end. In the preferred embodiment, the shaft is continuously rotatable

on the arm about a shaft axis. Shaft rotation may be by means of a motor with a suitable gear box also mounted on the arm that turns the shaft at a slow speed. The motor may be spring actuated. Alternately, an electric motor may be employed.

The grill of the invention is composed of a number of thin rods arranged in a plane and held in a frame. The frame extends out of the plane of the rods such that the frame forms an edge around the grill. The chains may be connected to the frame.

The weight of the grill and chains tends to pivot the arm such that it contacts the crank mechanism pad proximate the arm first end. By turning the crank, the arm pivots in a vertical plane relative to the bracket.

It is a feature of the invention that its components are easily disassembled, transported, and reassembled. In particular, the control head is removeable from the control head, and the arm is removeable from the bracket without the use of any tools. Further, the chains disconnect from the grill and from the shaft in the arm. To further enhance the portable nature of the present invention, the arm may be in two pieces. The post is also preferably in several pieces, such as two interfitting columns and a center stake that fits into the base. In that manner, the portable cooking equipment of the invention is readily packaged in a box or the like for transportation and storage.

To use the portable cooking equipment of the invention, the post lower end is inserted into the ground close to a fire ring or pit. The control head is placed on the post upper end. The arm pin is supported in the control head bracket, with the arm under the bracket second plate. The grill is hung from the arm by the chains such that the grill is over a fire. The grill can

be swung in a horizontal plane by means of the control head rotating on the post upper end. The locking screw can be tightened to retain the control head and grill at a desired location relative to the fire. Turning the crank causes the arm and pin to pivot in the control head bracket, thus adjusting the height of the grill in a vertical plane. The screw and nut design produces stepless increments in raising and lowering the grill relative to the fire. The motor rotates the grill in a horizontal plane over the fire. The edge formed by the grill frame prevents food from sliding or rolling off the grill. The user can keep his eye on the cooking food at all times while adjusting the grill height. After use, the portable cooking equipment is disassembled for easy transportation away from the cooking site.

In an alternate embodiment of the invention, the arm is pivotally supported between two first plates of the control head bracket. A pin passes through holes in both the first plates and the arm. The arm remains with the control head as one assembly during use, transport, and storage.

The method and apparatus of the invention, using a crank mechanism for height adjustment of the grill, thus enables food to be cooked over an open fire in a convenient way. The probability of over-cooking the food is remote, because the grill is easily and steplessly adjustable in multiple degrees of freedom.

Other advantages, benefits, and features of the invention will become apparent to those skilled in the art upon reading the detailed description of the invention and studying the drawings.

Brief Description of the Drawings

Fig. 1 is an exploded view of the portable cooking equipment of the present invention.

Fig. 2 is a front view of the assembled

portable cooking equipment of the present invention.

Fig. 3 is top view of the portable cooking equipment.

Fig. 4 is an exploded and broken front view on an enlarged scale of the arm of the invention.

Fig. 5 is a top view of Fig. 4.

Fig. 6 is an end view on an enlarged scale of Fig. 4.

Fig. 7 is a view on an enlarged scale taken along line 7-7 of Fig. 2.

Fig. 8 is a front view of an alternate control head according to the invention.

Fig. 9 is a top view of Fig. 8.

Fig. 10 is an end view of Fig. 8.

Detailed Description of the Invention

Although the disclosure hereof is detailed and exact to enable those skilled in the art to practice the invention, the physical embodiments herein disclosed merely exemplify the invention, which may be embodied in other specific structure. The scope of the invention is defined in the claims appended hereto.

Referring first to Figs. 2 and 3, portable cooking equipment 1 is illustrated that includes the present invention. The portable cooking equipment 1 is particularly useful for cooking food over an open fire 3. However, it will be understood that the invention is not limited to outdoor applications.

The portable cooking equipment 1 illustrated is comprised of a support 5 that pivotally supports an arm 7. A grill 9 is hung from the arm 7 by multiple chains 11.

In the preferred embodiment, the portable cooking equipment 1 is designed for exceptionally easy assembly, disassembly, transport, and storage. For that purpose, the portable cooking equipment is comprised of

several relatively small components that are easily assembled to and disassembled from each other without tools to make larger components that carry out the present invention. Fig. 1 illustrates the present invention in exploded form so as to assist describing the features related to assembly and disassembly of the components. It will be appreciated, of course, that components made as single pieces rather than multiple assembleable pieces are also well within the scope of the invention.

The particular structures illustrated having multiple assembled components include a post 13 comprised of four major components: a stake 16, base 19, upper column 20, and lower column 23. The base 19 has a flat plate 24 and a hub 26 that receives the stake 16. The stake has a diametrical hole 28 for receiving a stake pin 30. The post lower column 23 includes a pilot 25 that is fitable into the upper column 20. The post defines a post axis 31.

Also part of the support 5 is a control head 27 that interfits with the post 13. In the illustrated construction, the control head 27 interfits with the post by means of a sleeve 29 designed to loosely fit over the post upper column 20. A locking screw 33 may be incorporated into the sleeve 29. Alternately, a short stub shaft, not illustrated, may be used in place of the sleeve 29. In that case, the stub shaft is received inside the post upper column, and the locking screw is on the upper column.

The control head further comprises a bracket 34 having a first plate 35 welded to the sleeve 29 so as to close the sleeve end 37. At a right angle to the first plate 35 is a second plate 39. As illustrated, there is a U-shaped cutout 41 in the second plate 39. The bracket also has a third plate 43 parallel to the first plate.

The third plate 43 is shown as being on the same side of the second plate 39 as the first plate such that the bracket has a generally C-shape, Fig. 7. The particular bracket 34 has a single second plate 39. Optionally, the bracket may have two spaced apart parallel plates 39, each with its own cutout 41.

A crank mechanism 45 is part of the control head 27. The crank mechanism 45 includes a nut 47 fixed to the bracket third plate 43. A crank has a screw 49 that mates with the nut 47. A handle 51 with a knob 53 is on one end of the screw 49. On the free end of the screw is a pad 55. When the control head 27 is interfit with the post 13, the post axis 31 is preferably offset from the axis 58 of the screw by a distance D, Fig. 7. As illustrated, the screw axis 58 is between the bracket second plate 39 and the post axis.

Also looking at Figs. 4-6, the arm 7 has a first end 54 and a second end 63 and preferably is made with a front tube 64 and a rear tube 66, each having a rectangular cross section. The front tube 64 is shown with a pilot 70 that enters the rear tube 66 and is held there by a removeable pin 72. A pin 57 having a longitudinal axis 59 is welded to a top wall 52 of the rear tube 66. In the particular construction illustrated, the pin 57 is closer to the arm first end 54 than to the second end 63. The pin has a head 61 spaced a short distance from the side wall 74 of the rear tube. The pin is designed to enter the bracket cutout 41, with the longitudinal axis 59 perpendicular to the post axis 31. The pin head 61 cooperates with the arm side wall 74 to support the arm for pivoting in a vertical plane in the bracket cutout. When the arm is supported in the bracket, the crank mechanism pad 55 is contactable with the arm. If desired, and as shown, the arm includes a shallow cup 76 that receives the pad. If the bracket has two plates

39, then the arm is between the two plates, and the pin 57 is long enough to be supported in cutouts 41 in both plates. To give the arm a finished appearance, decorative end caps may be pushed into the arm at its ends 54 and 63.

On the second end 63 of the arm 7 is a vertically oriented shaft 65. It is from the shaft 65 that the chains 11 are hung. The shaft is rotatable by means of a motor 67 mounted on the arm. The motor 67 includes a gear box that rotates the shaft about a shaft axis 68 at a slow speed. The motor may be spring actuated. Alternately, the motor may be an electric motor.

To mount the motor 67 to the arm 7, a mounting plate 80 is welded or otherwise joined to the arm front tube 64. The mounting plate 80 has a base section 83 and two tabs 85 upstanding from the base section. There is a hole 87 through the base section 83, and there is a smaller concentric hole 89 through the front tube. A bushing 91 is inserted in the tube hole 89. The bushing 91 has a thin flange 93 that fits in the mounting plate hole 87.

The motor 67 is assembled to the mounting plate 80 by means of slots that receive the mounting plate tabs 85. If desired, a magnetic sheet can be bonded to either the motor or to the mounting plate base section 83 to help hold the motor in place. The shaft 65 has a circular cross section that rotates in the bushing 91, and a non-circular section 94 that enters a matching drive cavity in the motor.

The grill 9 is illustrated as having a rectangularly shaped periphery. It will be appreciated, of course, that a square or circular shape is also well within the scope of the present invention. The grill is composed of a number of thin rods 69 arranged to lie in a

flat plane 71. The rods 69 are held in a frame 73. It is a feature of the invention that the frame 73 projects upwardly from the plane 71. Consequently, the frame forms an edge around the grill that prevents food from sliding or rolling off.

The weight of the grill 9 and chains 11, plus the weight of the arm 7 between its second end 63 and the pin 57, causes the arm to pivot in the direction of arrow 81 in the bracket cutout 41. As a result, the arm pivots such that the cup 76 contacts the crank mechanism pad 55. By turning the crank handle 51 in opposite directions, the arm and pin steplessly pivot in the directions of arrows 81 and 82.

As mentioned, it is an important feature of the invention that the various components are easily assembled and disassembled. To do so, the grill 9 and chains 11 disconnect from the arm 7, the arm is removeable from the bracket cutout 41, and the control head 27 is removeable from the post 13. The two post columns 20 and 23 are disassembleable from each other, as are the arm tubes 64 and 66. The lower post column 23 is removeable from the stake 16, and the stake is removeable from the base 19. The pin 30 aids in removing the stake from the ground. In that manner, the portable cooking equipment 1 can be conveniently taken apart without the use of any tools. The entire portable cooking equipment is thus broken down into a number of relatively small components for easy packaging, transport, and storage.

Similarly, the portable cooking equipment 1 is easily assembled at a cooking site. The post 13 is first inserted into the ground 75 near a fire ring or pit 77. To do so, the stake 16 is pushed into the ground 75 through the base hub 26. If the ground is extremely hard, a leaded steel cap 95 is interposed between the stake and a hammer or the like that is used to pound the stake into

the ground. To provide additional stability to the post, several ground stakes 97 can be inserted through holes 99 in the base plate 24 and into the ground. The stake pin 30 limits the insertion depth of the stake 16 relative to the base. The post lower column 23 is placed over the stake, and the upper column 20 is placed on the lower column. The control head sleeve 29 is placed on top of the post upper column, and the arm pin 57 is placed in the bracket cutout 41. The chains 11 and grill 9 are hung from the shaft 65. The control head is rotatable in the directions of arrows 79 to swing the grill away from the pit 77 until the fire 3 is prepared. Then the control head is rotated to swing the grill back over the fire, and the locking screw 33 is locked. The motor 67 is actuated to continuously rotate the grill over the fire it the direction of arrow 78. At any time, operating the crank mechanism 45 causes the arm 7 to pivot in the directions of arrows 81 and 82 to adjust the height of the grill above the fire.

The result is that the food on the grill 9 is moveable relative to the fire 3 in three degrees of freedom: continuous unidirectional rotation of the grill about the shaft axis 68 in a horizontal plane over the fire, arrow 78; horizontal swinging toward and away from the fire about the post axis 31, arrows 79; and vertical height adjustment over the fire about the pin longitudinal axis 59, arrows 81 and 82. The crank mechanism produces stepless height adjustments so the perfect distance above the fire for the cooking task at hand is always possible. Further, operating the crank mechanism 45 is achieved using a single hand, and without diverting attention from the fire and cooking food.

Figs. 8-10 show an alternate portable cooking equipment 101 according to the present invention. The portable cooking equipment 101 has a control head 103

that is generally similar to the control head 27 described above in conjunction with Figs. 1-7. That is, the control head 103 has a bracket 105 with a first plate 35′ welded to a sleeve 29′. There is a locking screw 33′ on the sleeve 29′. Two spaced apart second plates 106 are at a right angle to the first plate 35′. A third plate 108 spans the second plates 106 and is parallel to the first plate 35′. The control head 103 further comprises a crank mechanism 45 that is substantially identical to the crank mechanism 45 of the control head 27 described previously.

An arm rear tube 66′ is pivotally supported in the control head 103 by means of a pin 107. The pin 107 passes through the control head second plates 106 and through the arm rear tube 66′. The pin 107 may be held in place by a retaining ring 109. If desired, spacers 111 can be used between the plates 106 and the arm rear tube 66′. After initial assembly, the arm tube 66′ remains assembled to the control head 103. In all other respects of construction and operation, the portable cooking equipment 101 is virtually identical to the previously disclosed portable cooking equipment 1.

In summary, the results and advantages of open fires 3 can now be more fully realized. The portable cooking equipment provides both stepless height adjustment of the grill 9 above the fire, as well as easy assembly and disassembly. This desireable result comes from using the combined functions of the control head and the arm 7. The control head is rotatable on the post 13 to swing the grill horizontally toward and away from the fire. The motor 67 rotates the shaft 65 from which the grill and chains 11 are hung. The arm is pivotable in the control head to raise and lower the grill in response to turning the crank mechanism. The crank mechanism produces stepless height adjustments of the grill. The entire

portable cooking equipment is easily disassembled for transport and storage.

It will also be recognized that in addition to the superior performance of the portable cooking equipment of the invention, its construction is such as to cost little, if any, more than traditional open-fire cooking apparatus. Also, since the invention is made of a simple design and rugged components, it will give long service life with but minimal maintenance.

Thus, it is apparent that there has been provided, in accordance with the invention, portable cooking equipment that fully satisfies the objects, aims, and advantages set forth above, while the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications, and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, it is intended to embrace all such alternatives, modifications, and variations as fall within the spirit and broad scope of the appended claims.

We Claim:

1. Portable cooking equipment comprising:

a. an arm having first and second ends:

b. a grill hung from the arm first end; and

c. means for supporting and steplessly pivoting the arm in a vertical plane relative to the ground,

so that the grill is steplessly adjustable in the vertical plane.

2. The portable cooking equipment of claim 1 wherein the means for supporting and steplessly pivoting the arm comprises a support inserted into the ground and comprising a control head in operative association with the arm to steplessly pivot the arm in response to operating the control head.

3. The portable cooking equipment of claim 2 wherein:

a. the support further comprises a post defining a post axis and having a first end inserted into the ground, and a second end;

b. the control head interfits with the post second end for rotating thereon about the post axis; and

c. the control head comprises a crank mechanism in contact with and selectively operable to pivot the arm.

4. The portable cooking equipment of claim 1 wherein the means for supporting and pivoting the arm comprises:

a. a post having a first end inserted into the ground, and a second end, and defining a post axis; and

b. a control head comprising:

i. a bracket that interfits

with the post second end for rotating about the post axis, the bracket defining means for pivotally supporting the arm; and

ii. a crank mechanism on the bracket in contact with the arm, the arm pivoting relative to the bracket in response to operating the crank mechanism.

5. The portable cooking equipment of claim 4 further comprising means for retaining the bracket from rotating about the post axis.

6. The portable cooking equipment of claim 4 wherein:

a. the bracket comprises at least one first plate that pivotally supports the arm, and a second plate; and

b. the crank mechanism comprises a nut fixed to the bracket second plate, and a screw mating with the nut and in contact with the arm,

so that turning the screw causes the arm to pivot steplessly in the at least one bracket first plate.

7. The portable cooking equipment of claim 6 wherein:

a. the at least one bracket first plate defines a cutout; and

b. the arm comprises a pin that is pivotally supported in the at least one bracket cutout,

so that the arm is supported for pivoting in the bracket.

8. The portable cooking equipment of claim 7 wherein the pin comprises a head that cooperates with an associated wall of the arm to pivotally support the arm in the bracket.

9. The portable cooking equipment of claim 6 wherein the crank mechanism screw defines a screw axis

that is non-concentric with the post axis.

10. The portable cooking equipment of claim 1 wherein:

a. the arm comprises a motor mounted thereto proximate the arm first end, and a shaft turnable in response to operating the motor; and

b. the grill is hung from the shaft.

11. The portable cooking equipment of claim 1 wherein the grill comprises:

a. a plurality of rods arranged in a flat plane; and

b. a frame that holds the rods and that extends out of the flat plane to form an edge around the grill that prevents food placed on the rods from rolling or falling off the grill.

12. The portable cooking equipment of claim 4 wherein:

a. the bracket comprises two spaced apart first plates that pivotally support the arm therebetween, and a second plate spanning between the second plates; and

b. the crank mechanism comprises a nut fixed to the bracket second plate, and a screw mating with the nut and in contact with the arm,

so that turning the screw causes the arm to pivot steplessly in the bracket first plates.

13. Apparatus for cooking food comprising:

a. a post at a selected distance from a fire and defining a generally vertical axis;

b. a control head rotatable on the post about the vertical axis;

c. an arm supported in the support for steplessly pivoting about a horizontal axis in response to operating the control head; and

d. a grill hung from the arm over the

fire, so that operating the control head steplessly adjusts the height of the grill over the fire.

14. The apparatus of claim 13 wherein the control head comprises:

a. a bracket including means for interfitting on the post for rotation about the vertical axis, and further including means for pivotally supporting the arm; and

b. a crank mechanism in operative association with the bracket and the arm and selectively operable to steplessly pivot the arm.

15. The apparatus of claim 14 wherein:

a. the means for pivotally supporting the arm comprises at least one plate that defines a cutout; and

b. the arm comprises a pin pivotally supported in the at least one plate cutout, the pin defining the horizontal axis.

16. The apparatus of claim 15 wherein the pin comprises a head that cooperates with a wall of the arm to pivotally support the arm in the at least one bracket plate cutout.

17. The apparatus of claim 14 wherein the crank mechanism comprises:

a. a nut fixed to the bracket; and

b. a crank having a screw that mates with the nut and contacts the arm,

so that turning the crank causes the arm to steplessly pivot about the horizontal axis.

18. The apparatus of claim 13 wherein the arm comprises a motor, and a shaft rotatable in the arm by the motor, and wherein the grill is hung from the shaft,

so that the grill is continuously rotatable in a horizontal plane over the fire.

19. The apparatus of claim 13 wherein the

grill comprises:

a. a plurality of rods lying in a flat plane; and

b. a frame around the rods and extending out of the flat plane thereof to prevent food on the rods from rolling or falling off the grill.

20. The apparatus of claim 13 further comprising means for continuously and unidirectionally rotating the grill in a horizontal plane over the fire.

21. The apparatus of claim 14 wherein the means for pivotally supporting the arm comprises:

a. a pair of spaced apart plates; and

b. a pin passing through the plates and the arm, the pin defining the horizontal axis.

22. A method of cooking food comprising the steps of:

a. providing a support at a selected distance from a fire;

b. supporting an arm in the support for pivoting in a vertical plane;

c. hanging a grill from the arm over the fire; and

d. stepless pivoting the arm in the support and thereby steplessly adjusting the height of the grill over the fire.

23. The method of claim 22 wherein:

a. the step of providing a support comprises the steps of providing a post, and interfitting a control head having a crank mechanism on the post;

b. the step of supporting an arm comprises the step of pivotally supporting the arm in the control head; and

c. the step of steplessly pivoting the arm comprises the step of operating the crank mechanism for contacting and steplessly pivoting the arm.

24. The method of claim 22 comprising the further step of continuously and unidirectionally rotating the grill in a horizontal plane over the fire.

25. A method of changing the location of a grill over a fire comprising the steps of:

a. hanging the grill from an arm;

b. swinging the arm and grill in a horizontal plane about a first axis toward and away from a fire; and

c. steplessly pivoting the arm in a vertical plane about a second axis and thereby steplessly adjusting the height of the grill over the fire.

26. The method of claim 25 wherein the step of steplessly pivoting the arm comprises the steps of:

a. inserting a post into the ground;

b. interfitting a control head on the post for rotating about the first axis;

c. supporting the arm in the control head;

d. providing a shaft in the arm that defines a third axis generally parallel to the first axis;

e. hanging the grill from the arm shaft;

f. operating the control head for steplessly pivoting the arm about the second axis; and

g. continuously rotating the shaft about the third axis and thereby continuously rotating the grill about the third axis.

27. The method of claim 26 wherein the step of operating the control head comprises the steps of:

a. providing a crank mechanism in the control head;

b. contacting the arm with the crank mechanism; and

c. operating the crank mechanism and

steplessly pivoting the arm.

28. The method of claim 25 comprising the further step of continuously and unidirectionally rotating the grill in a horizontal plane over the fire about a third axis,

so that the grill is moveable relative to the fire in three degrees of freedom.

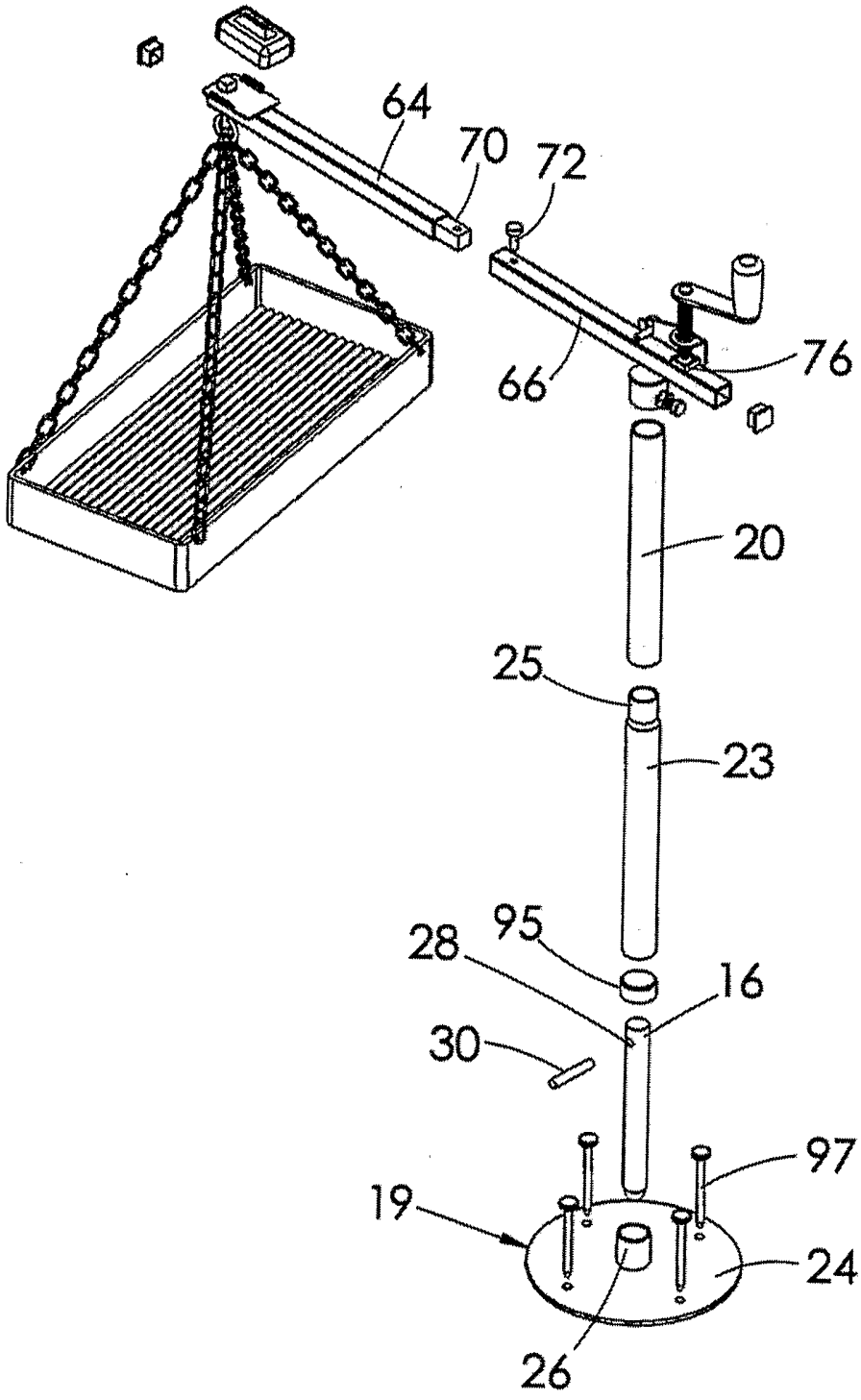

FIG. 1

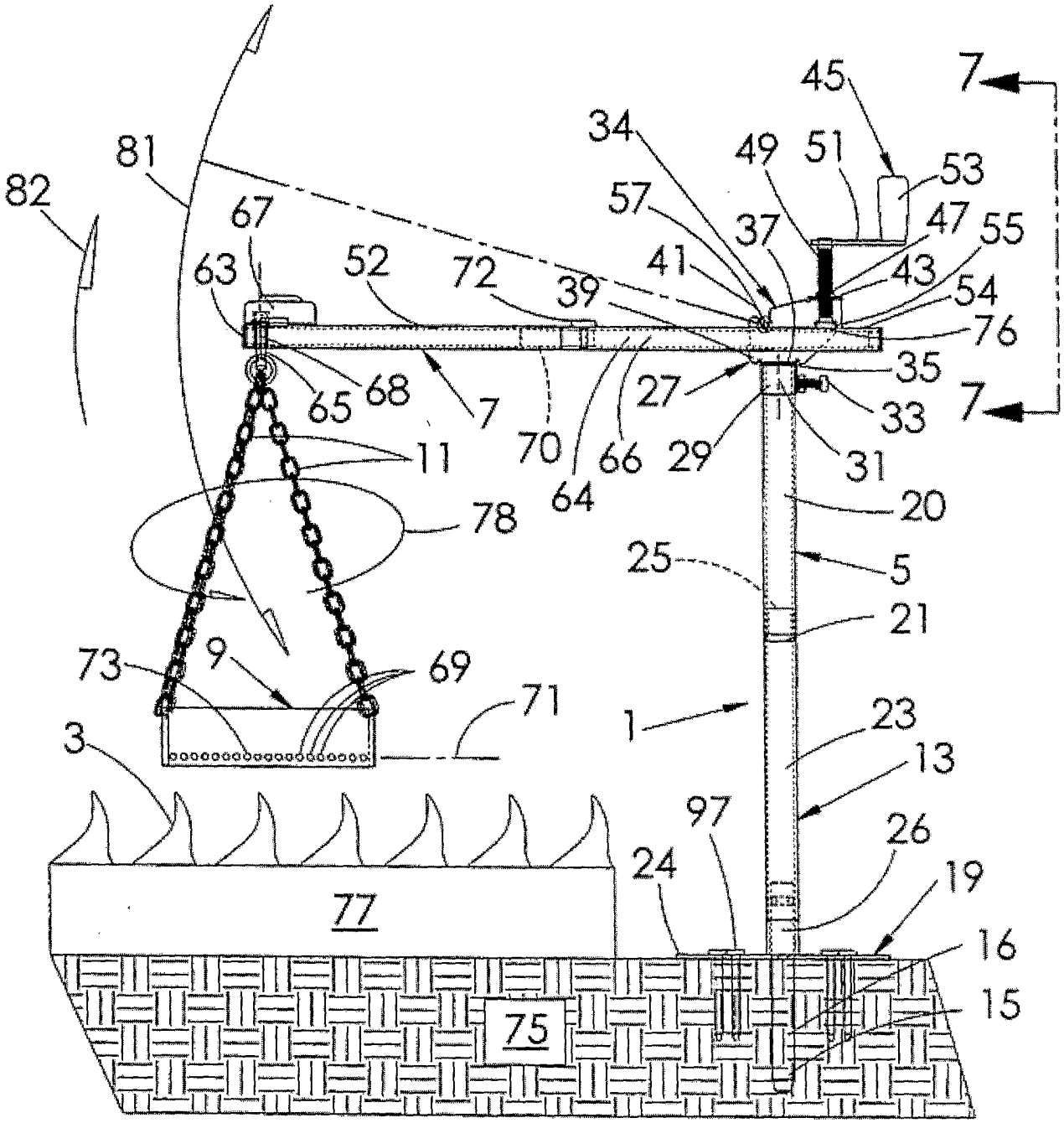
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FIG. 2

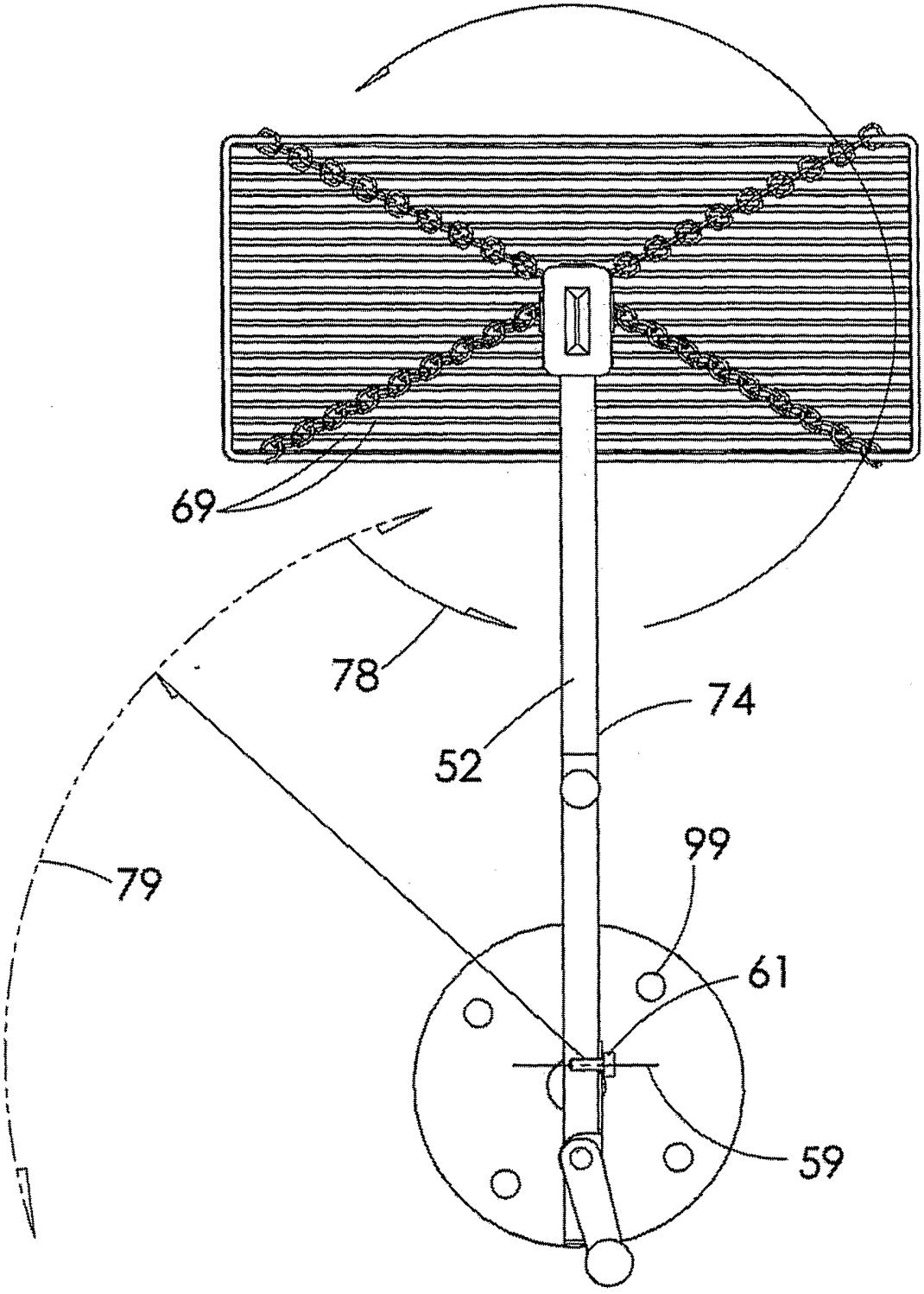


FIG. 3

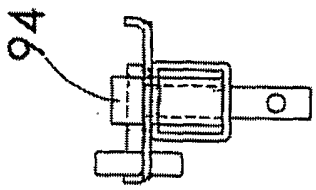


FIG. 6

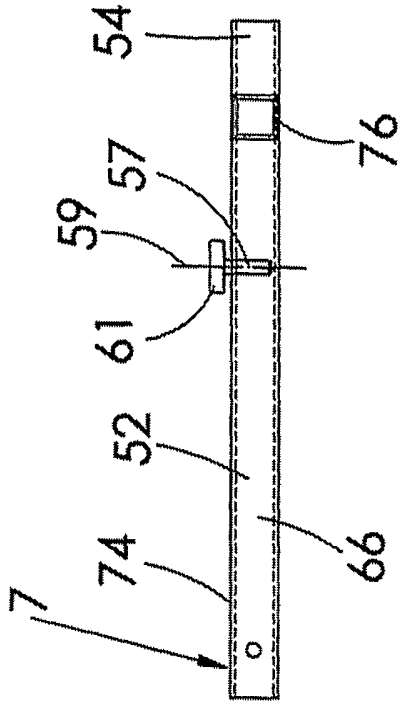
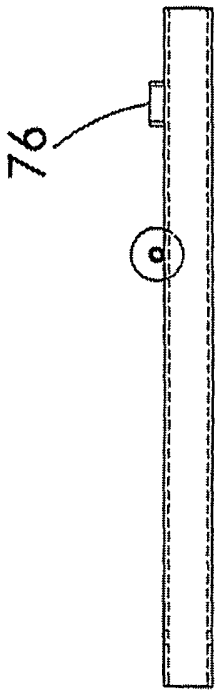


FIG. 5



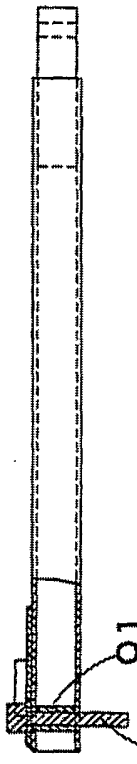
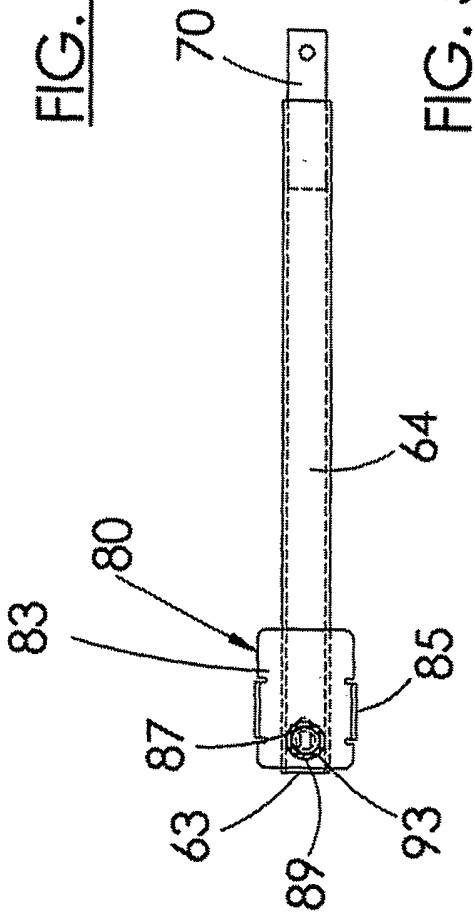


FIG. 4



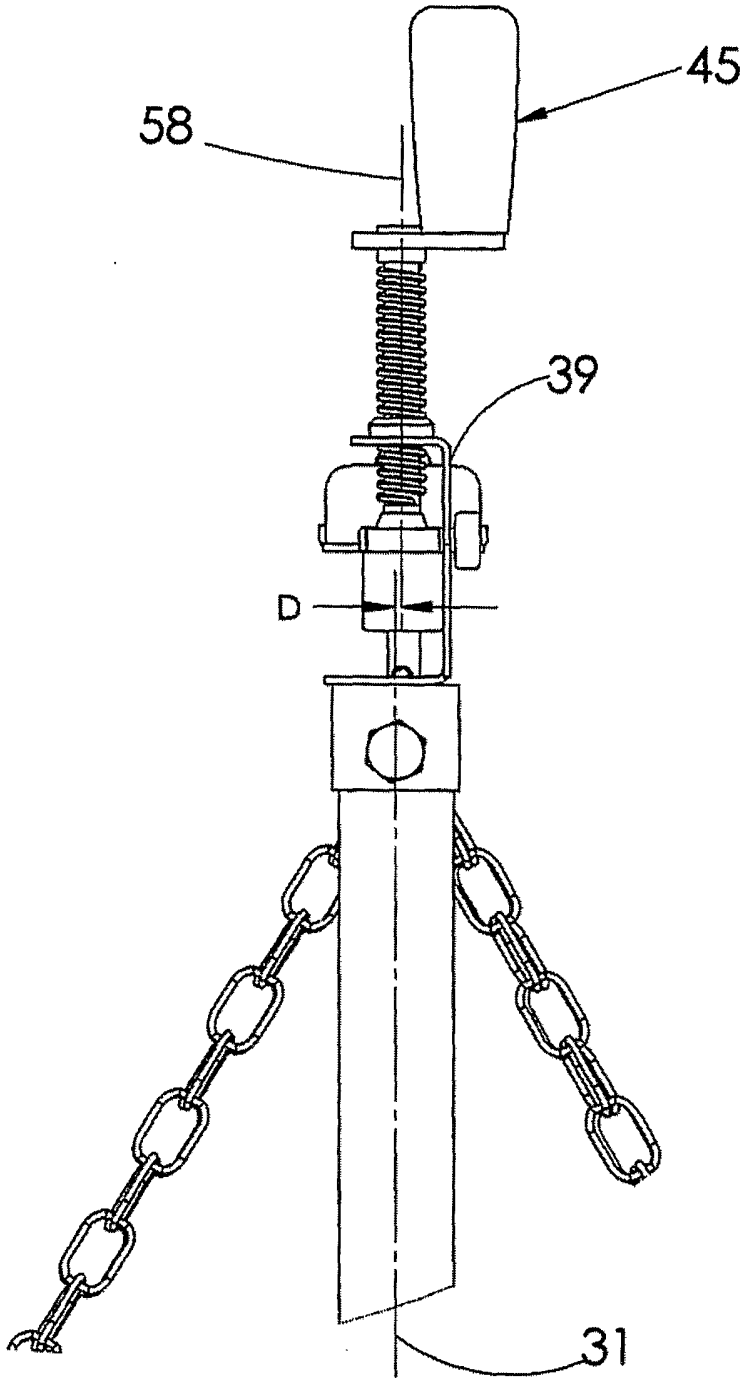


FIG. 7

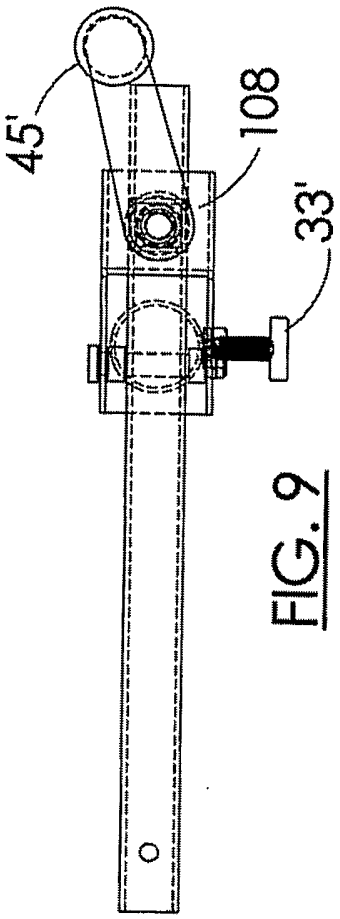


FIG. 9

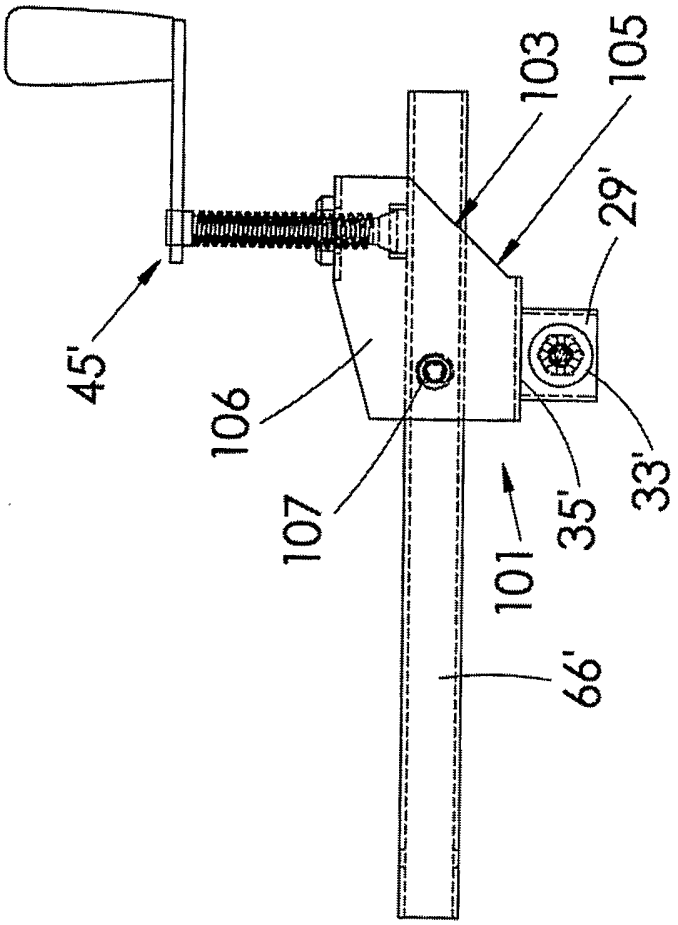


FIG. 8

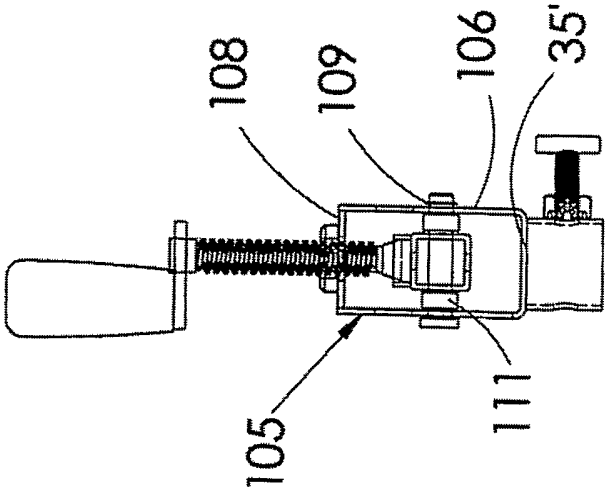


FIG. 10